AMATEUR WORK

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A CHAMBER SET.

JOHN F. ADAMS.

The Bureau.

The general dimensions for the bureau are: Size of mirror, 42x30″; top board over drawers, 50x22″. Other sizes can be worked out by any-one desiring, the general proportions being retained. The stock required is as follows:

2 pieces	36″ long	2½x1¾″	
2 "	64 " "	2½x1¾″	
2 "	30 " "	17½″ wide	⅞″ thick
4 "	45 " "	3 " "	⅞″ "
2 "	45 " "	2 " "	⅞″ "
2 "	33 " "	2 " "	⅞″ "
1 "	50 " "	22 " "	⅞″ "
2 "	43 " "	9½″ "	⅞′. "
2 "	21½″ "	6 " "	⅞″ "

30 feet of ⅞″ white wood strips 2½″ wide, and white wood for sides and bottoms of drawers, etc.

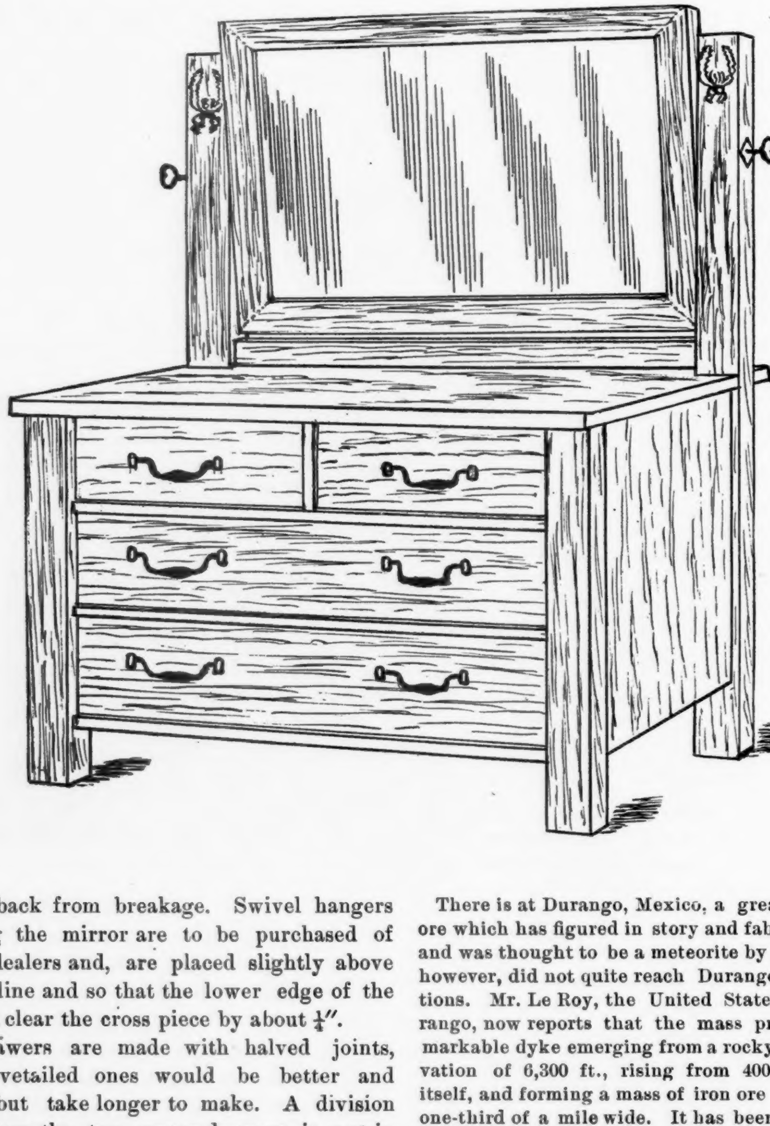
The first operation is to cut mortices in the front posts to receive the ends of the cross piece under the lower drawer. This cross-piece is 45″ long, 3″ wide and ⅞″ thick, allowing 1″ on each end for tenons, which are 3x½″. The posts are 36″ long, 2½″ wide and 1¾″ thick, the mortices being cut with lower edge 6″ from the end. The rear posts are 64″ long, 2½″ wide and 1¾″ thick. Mortices are cut in these posts for the cross piece under the mirror frame, which is 45″ long, 3″ wide and ⅞″ thick, the mortices being 3x1x½″, and the lower edges 36⅞″ from the end of the posts.

The end pieces 30″ long, 17½″,wide and ⅞″ thick, are then glued to the posts after marking out and boring six ⅜″ holes into each edge to a depth of about 4″ and corresponding holes in the posts into which dowel pins are glued. The edges of the end boards are well coated with glue and the ends are then set up in clamps until thoroughly dry. The outer surface of the end board is set in $\frac{3}{16}$″ from the posts.

While the ends are drying the drawer runs are made from strips of whitewood 2½″ wide with the exception of the front sides of the runs under the top and middle drawers, which are of the same wood as the bureau, and the one under the lower drawer which has the cross piece for the outer edge and a piece of white wood just back of and glued to it. The frame under the upper drawers also has a cross piece in the centre which is morticed in. The corners of these frames are cut out to fit the posts. When completed they are screwed to the ends after the cross piece under the lower drawer and mirror have been put in place. Cabinet-makers' clamps must be used while the glue is setting. The frame under the top drawer is placed 7″ from the top ends of front posts, that under the middle drawer 9½″ below the first, and the lower frame is flush on the upper side with the top of the cross piece. An additional frame is then made of ¾″ strips or of solid stock 48″ long and 21″ wide and attached firmly with wood screws to the top of the front posts and end boards. The top, 50″ long, 22″ wide and ⅞″ thick, is then put on, glue and screws from the under side being used freely to secure ample strength. A suitable moulding is run around the under edge, covering the edges of the under frame. The frame for the mirror is made of ⅞″ stock 2″ wide, the longer pieces being 44¾″ long and the side pieces 33″ long. The corner joints

are mitred on front side, and mortised and tenoned also. The inner back edge is rabbeted $\frac{1}{2}$x$\frac{3}{8}$″ to receive the mirror, picture backing being used

The back of the bureau is sheathed with $\frac{1}{2}$″ matched sheathing, the inner edges of the drawer runs being placed to allow for this.



to protect back from breakage. Swivel hangers for holding the mirror are to be purchased of hardware dealers and, are placed slightly above the centre line and so that the lower edge of the mirror will clear the cross piece by about $\frac{1}{4}$″.

The drawers are made with halved joints, though dovetailed ones would be better and stronger, but take longer to make. A division piece between the two upper drawers is put in before putting on the top. By examining the drawers in any bureau the method for making them can be easily learned, so is not here given. The drawer pulls should be of cast brass; castors are also fitted to the bottom of the posts.

There is at Durango, Mexico, a great mass of iron ore which has figured in story and fable for 300 years, and was thought to be a meteorite by Humboldt, who, however, did not quite reach Durango in his explorations. Mr. Le Roy, the United States consul at Durango, now reports that the mass proves to be a remarkable dyke emerging from a rocky plain at the elevation of 6,300 ft., rising from 400 ft. to 650 ft. in itself, and forming a mass of iron ore a mile long and one-third of a mile wide. It has been calculated that it contains 500 to 600 million gross tons above the surface, while there are no means of knowing what may be below. The ore is a hard specular hematite, with, on an average, 60 per cent of metallic iron, much of it going up even to 67 per cent.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

V. Plain Cored Cylinders — Small Gland.

In the last chapter I explained the difference between green sand and baked sand cores, and the use of core boxes and core prints. In practice, usually, no regular hole less than 1″ in diameter should be cored.

The size and shape of holes govern, to a large extent, the construction of patterns. Fig. 29 shows the casting of a small gland. This is a very simple pattern, yet there are at least six different methods of making the pattern, any one of

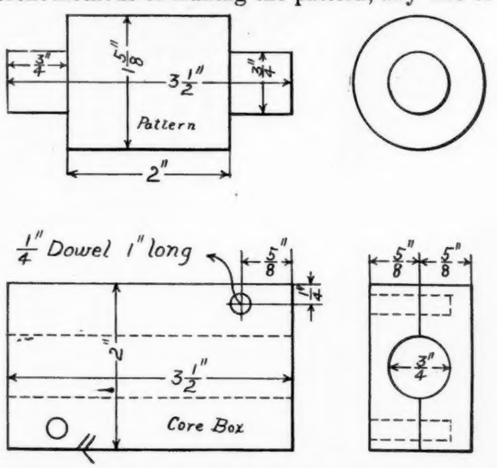


FIG. 22. PATTERN AND CORE BOX FOR CYLINDER

which might be followed. In all cases where the length of the casting nearly equals, or even exceeds, four times the diameter of the hole to be cored out, it has been found advisable to mold the pattern in a horizontal position, thus making use of a horizontal core. Even in short patterns when the diameter of the hole approaches that of the external diameter, this method is often found to be of great use, since it is difficult for the molder to tell when his core is accurately in place.

The following rules are used in the best pattern and foundry practice and should be constantly kept in mind:

1. A hole no deeper than its diameter should be formed by a green sand core.

2. Patterns where the holes are not longer than four times its diameter may be constructed so as to place the core in a vertical position.

3. Patterns where the hole is longer than four times its diameter, should generally be constructed as a "split" pattern and the core placed in a horizontal position.

PLAIN CORED CYLINDERS.

Fig. 22 shows the pattern and core box for a plain cylinder 2″ long and 1⅝″ diameter cored out for a ¾″ hole. We will assume that this casting is to finish up for a sleeve requiring an absolutely parallel hole. This cored hole then must be bored out parallel, and this can be much more readily done if the hole is cast parallel, because there will be less metal cut out. With

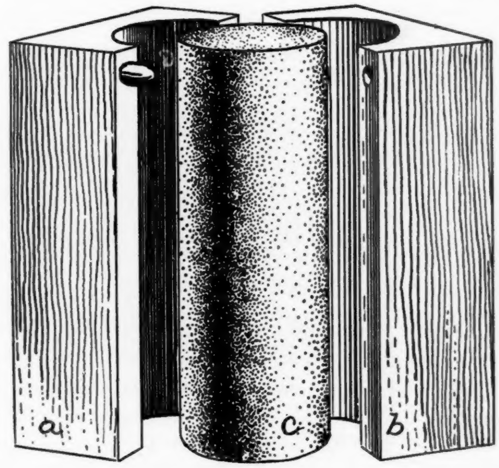


FIG. 23. CORE AND CORE BOX.

these considerations in mind we will decide to use a horizontal core with this pattern.

The kind of pattern to be made for this cylinder will depend principally on the number of castings required and the facilities at hand. When only a few castings are wanted a pattern will be turned out of one piece of stock, and having the same shape as the casting, core prints be added at

each end to leave recesses in the mold to receive the ends of the core. A pattern turned in this way greatly simplifies the work of the pattern maker, but throws additional labor on the molder, who must mold the pattern in one of three ways. The first method is shown in Fig. 27, the molder being forced to cut down the parting line of the mold. The pattern is shown at *a*, and it will be seen that the molder has cut away the sand along the lines *bc* and *de* so as to enable him to draw the pattern from the mold. This leaves the lower half of the mold simple enough, but the cope will have a heavy body of sand hanging from it, as shown at *f*. This generally is an objectionable feature and should be avoided if possible.

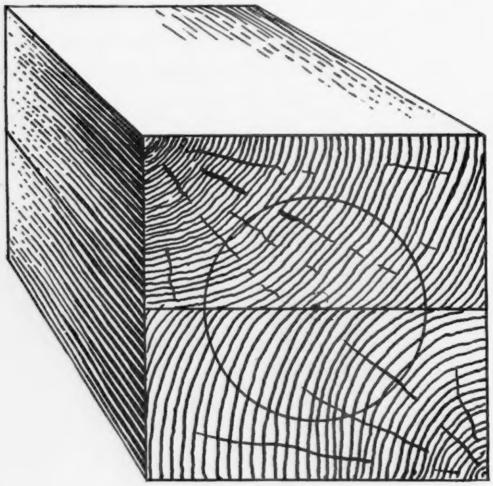


Fig. 24. Laying Out Core Box.

The second method is shown in Fig. 28. The parting line is all right, the main objection being that a hole the exact shape of the pattern cut deep enough to hold exactly half of the pattern, must first be cut in the base board or bottom board. This involves considerable labor, and the pattern is very liable to stick to the base board when it is lifted from the nowel, and making it necessary to patch up the mold formed in the nowel by the pattern.

Third method:—If a large number of castings are wanted, the pattern maker may use the solid pattern by making what is called an *odd side* or *match*. In this case the pattern is first embedded half of its depth in plaster or oil sand. The odd side is made in a box, which must be of the same size as the flask to be used for molding. If this is made of plaster it is allowed to harden, and if made of oil sand, it is dried until the material has become very firm. The plaster or sand is usually made to adhere to the box by means of nails driven on the inside of the box. When this *odd side* or *match* is ready for use, the pattern is laid in place in the *match* and the nowel placed over it. Sand is then rammed in, after which the whole is turned over, the odd side removed, and the molding proceeds as usual.

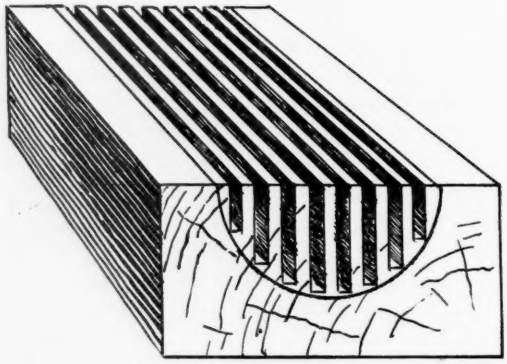


Fig. 25. Sawing Out Core Box.

When there are only a small number of castings required, a *jointed* or *split* pattern is generally used, since it greatly decreases the time required for molding the pattern. A split pattern for a recessed cylinder will be given in a later article.

Fig. 22 shows the solid form of pattern requiring a piece of clean, dry pine $4\frac{1}{2}''$ long and $1\frac{7}{8}''$ square. The pattern presents no difficulty in turning, the allowance for draft being made with a $\frac{1}{4}''$ skew chisel; be sure to give a little draft to the core print ends. The main body of the pattern is to be finished with black shellac and the core prints with orange shellac. The required number of coats of black shellac should be given to the pattern, and the core prints carefully cleaned free from black shellac before any orange shellac is applied.

The core box for this pattern is shown in Fig. 22 and Fig. 23. When small round cores are to be made, a core box of form *a-b*, Fig. 23, is used, *c* representing the core. To make such a core box, two pieces of stock are used, a little longer

than the required length of core and of such size as to leave sufficient stock for strength, after the the core has been cut out.

We will require for one core box two pieces of clear dry pine 3¾″ long and large enough to allow for planing on all sides to 2″ wide and ⅝″ thickness. The two pieces are to be held together deep. Wood dowels can be bought cut usually in lengths of three feet, and are made of maple, hickory, ash and oak. These pins may be prepared by the amateur if a hardened plate of steel bored with holes of the various sizes of dowel pins required can be procured. The wood for the pins having been planed up for the required size, is

FIG. 26. PATTERNMAKERS GUAGE.

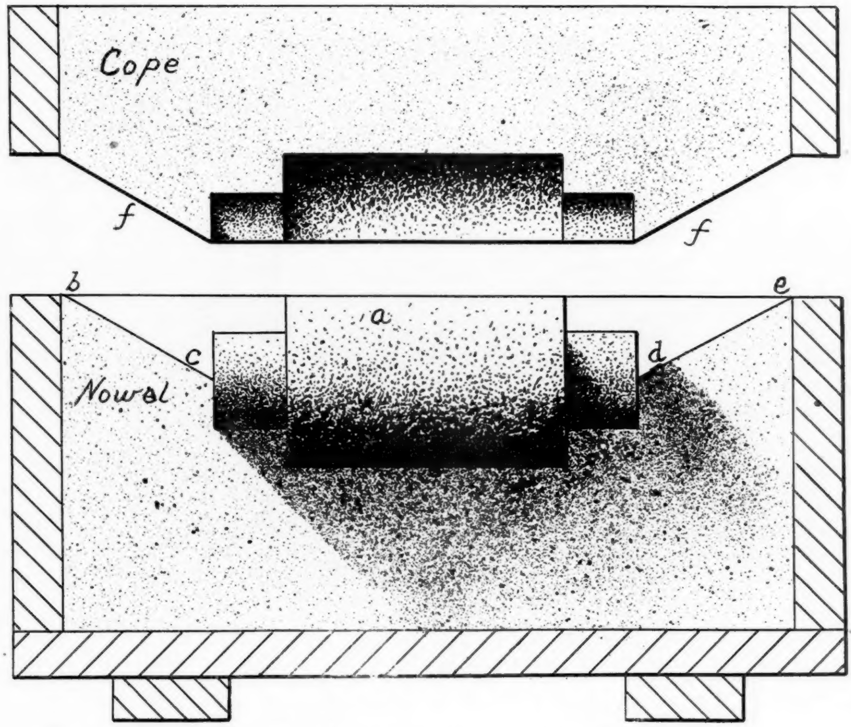


FIG. 27. METHOD OF MOLDING CYLINDER.

by two dowel pins 1″ long and ¼″ in diameter, holes being bored through the top piece and $\frac{7}{16}$″ into the bottom piece. The centers for the dowel holes are shown in Fig. 22. Having carefully marked the centres for these holes in the top surface of one of these blocks, clamp the two blocks evenly together, either with wood clamps or a vise, and bore the holes absolutely straight, using a depth gauge on the bit to prevent boring too driven with a mallet through the plate. This saves a great deal of time and makes the pins much more nearly round than is possible by hand work. Two dowels are cut off each 1″ long and glued into the top piece. The projecting end is tapered off so that the two halves of the core box will fit loosely. Having the two halves of the core box dowelled, clamp them together and mark a circle on each end equal to that of the re-

quired core, $\frac{3}{4}''$, care being taken to locate the centres at equal distances from the joint sides, and to have the centre on the line of division between the two pieces, as shown in Fig. 24, *c* indicating the centre of the required circle.

Next take the two blocks apart and draw lines across the face of each piece, joining the ends of the half circles. The greater portions of the stock between these lines can be removed by

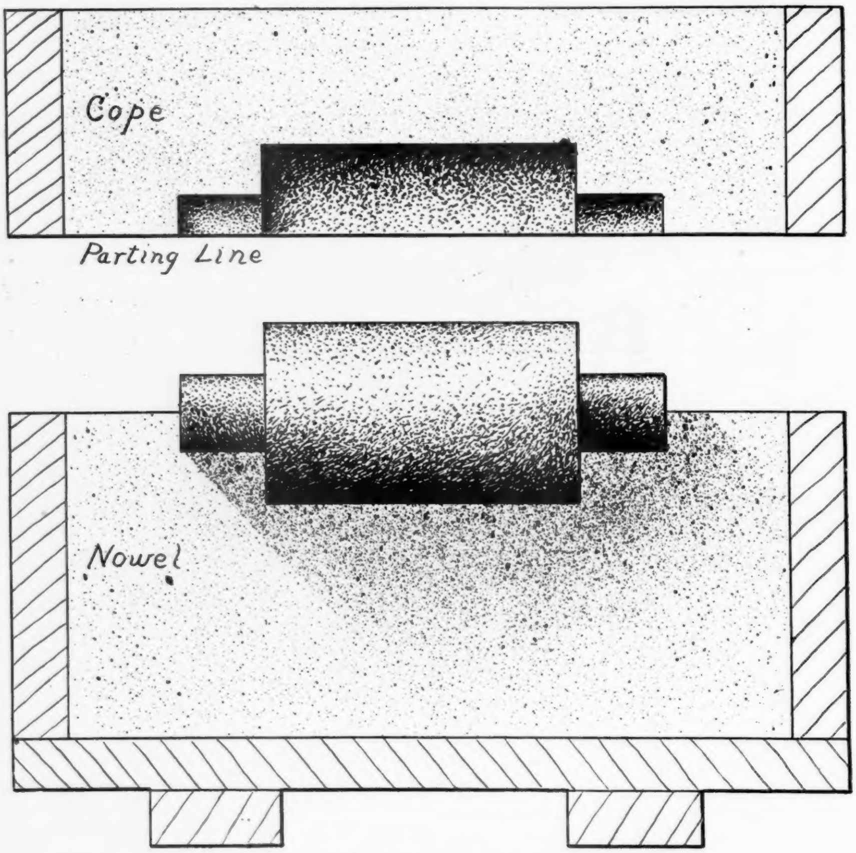


Fig. 28. Another Method of Molding Cylinder

means of a back saw, a series of parallel cuts being taken to approximate the half circle shown in Fig. 24. The remainder of the stock, allowing sufficient for sandpapering, is to be removed with the paring gouge or pattern maker's gouge, one of which is shown in Fig. 26. This gouge is bevelled on the inside. Some pattern maker's gouges are straight in the shank and others are bent, being made in all sweeps (curves) and widths.

The core box should be tested with the end of a scale or steel try square to make sure that each half is exactly a half circle. This method of testing depends upon the following well known principle:—Every triangle inscribed in a semi-circle, having the diameter of the circle as one side (this side being the hypothenuse) will have a right angle formed opposite this side, by the meeting of the other two sides of the triangle. The point which is the vertex of this right angle must continually touch the curved outline of the hole in every point as the scale is moved around. Turn a cylinder $1\frac{1}{8}''$ in diameter, and with sandpaper wrapped closely around it, sandpaper the two halves.

It will be remembered that I suggested making the core box $\frac{1}{4}''$ longer than the total length of pattern. This was done with our first core box in order that any breaking out of the curved surface at the ends of the box due to a cross grain or cutting outside of the lines at the ends might be removed. Of course in trimming up the ends of the core box generally, a cylinder of just the size of the hole should be inserted in order that the wood may not break out. After a little practice with the gouge, however, no difficulty should be met with in finishing up parts of the core boxes that are squared off exactly the right length.

Holes for core boxes are sometimes bored out with a bit or drill; this will be discussed in a later article. The outside of the core box is to be finished in black shellac, and the hole with orange shellac.

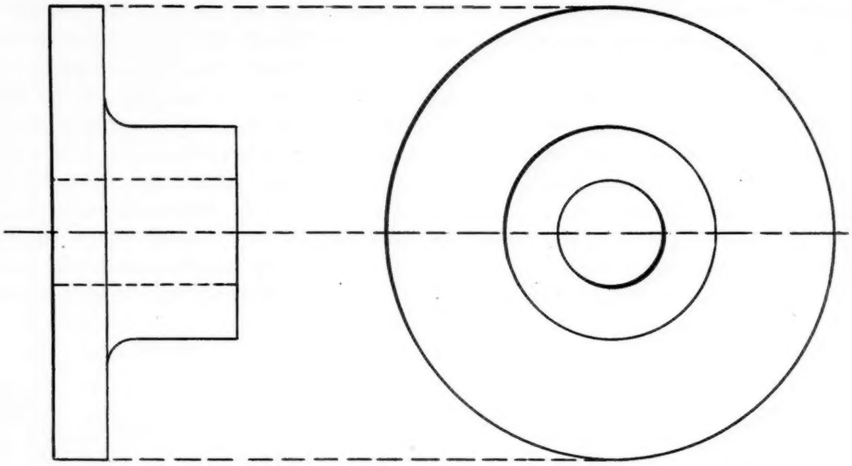


FIG. 29. PATTERN FOR SMALL GLAND WITH GREEN SAND CORE.

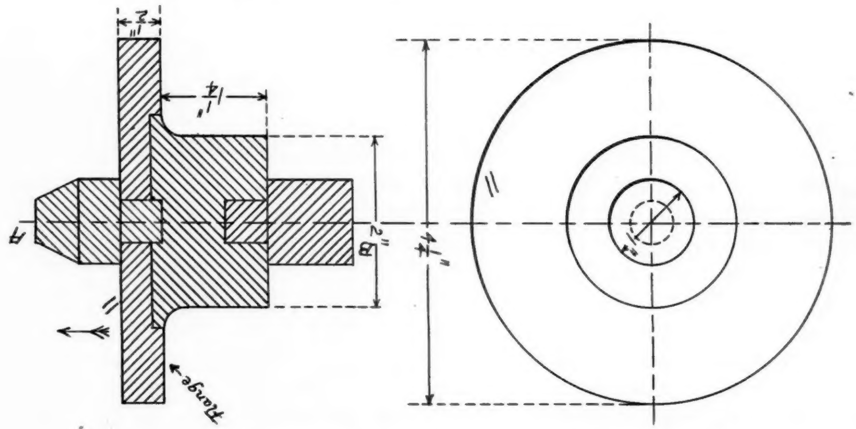


FIG. 30. PATTERN FOR SMALL GLAND WITH BAKED SAND CORE.

SMALL GLAND.

At the commencement of this present article I stated that the small gland, the casting of which is shown in Fig. 30, might be made in at least six different ways. I give below six different methods for making this pattern and give, very briefly, the advantages and disadvantages of each method.

1st method. Turn the pattern from a solid block, turning out or boring a hole tapered for draft, which, when the pattern is molded, will have a vertical green sand core. This is the simplest method, both as regards making and mold-

ing the pattern, since no baked sand core is required and the green sand is certain to be in the middle of the casting, which it rarely is where a baked sand core is used. The disadvantage of this is that decidedly more taper or draft to a hole in a pattern must be made than is necessary on the outside surface, and as the casting should have a parallel hole when finished, more metal must be removed in boring out than is the case where the hole had been cored parallel.

2nd method. Turn the pattern from a solid block and add core prints, using a vertical baked sand core. This is the method we shall follow in making the gland. The baked sand core will leave a parallel hole, therefore less metal will be required to be left for boring than would be necessary in the first method. Made in this way the gland is to be molded with the flange, Fig. 30, uppermost, the top core print being all that would be contained in the cope. The parting between cope and nowel comes, then, level with the top face of the flange. It will be noticed the top core print *A*, Figs. 30 and 31, is turned straight first and then tapered for $\frac{1}{2}''$. This taper is given so that the cope may be lifted off easily. When the core, which has its top end tapered exactly like the top core print, is set in position and the cope is set down on to the nowel ready for pouring, if the core has not been placed quite upright its tapered end may adjust itself to the tapered recess in the cope and thus correct any slight error of position of core. For large pattern work both top core print *A*, and bottom core print *B*, Fig. 30, should be tapered, starting from the shoulder where the core print enters the pattern proper; at this shoulder, however, the core print should be exactly the size of the core, otherwise with excesssive taper a useless space will be left around the core print into which metal will flow, producing a *web*, called a *fin*, around the hole and projecting from the end face.

For small work core prints for vertical cores made as shown in Fig. 31, will be found to be entirely satisfactory.

3rd method. If the casting is to be finished all over and is to be a gland for a piston rod, the outside surface of the flange must be absolutely free from blow or air holes. This will necessitate the pattern being molded so that the flange shall be downwards, in which case the under surface comes even with the parting surface between the cope and the nowel, the remainder of the pattern being in the cope. The soundest part of a casting is always at the bottom of the mold and is more dense, heavier and stronger than at the top of the mold, as the air or gas which does not escape from the mold will leave holes in the top of casting. In molding a pattern in this manner it will be found that the pattern should be made with the flange separate, the body of the pattern and the core prints being in one piece. The flange should fit freely to a parallel surface cut on the bottom core print, the under surface of the flange coming, of course, up against the body of the pattern. For glands of medium size this method is very largely used. In cases, however, where the length of the body is about three times the diameter of the cored hole, the horizontal position is best.

4th method. If the pattern is to be molded horizontally the core prints are not tapered and the pattern must be made solid, as was the plain cylinder just described. The amount of time required for molding such a pattern will cause us to turn to the next two methods.

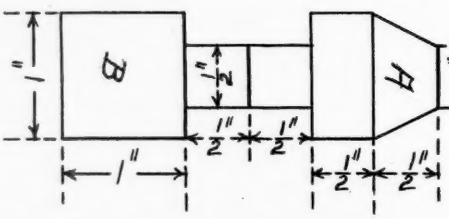


Fig. 31. Method for Turning Core Print.

5th method. Using this method the pattern is made as a split pattern, core horizontally, with the flange, which is, of course, split with the rest of the pattern, turned solid with the pattern. If the hub is small and if the flange does not greatly exceed it in diameter, this method is satisfactory. The great objection is that considerable draft is necessary on the other sides of the flange in order that the sides of the mold may not be broken when the halves are drawn from the mold.

6th method. If the hub is small and the flange is large, make the pattern as a split pattern cored horizontally, and turn two pieces for the flange separately, fitting easily a shoulder recessed in at the end of the hub of the pattern.

We will use the second method for making and molding this pattern. The right end view of Fig. 30 is in sections and shows the flange turned from a separate piece of stock, but is to be glued and nailed to the hub, making a solid pattern. If a piece of stock 2″ thick is available both flange and hub are to be turned from a solid block. In this mold we require a block $4\frac{1}{2}$″ square and 2″ thick. One side, which is to be the top surface of the flange, should be planed true. This side should come up against the screw centre plate. The hole for the lower core print *B*, Fig. 30, is to be turned out. The hole for the upper core print *A*, is to be bored out with a bit, the screw centre plate being removed from the lathe and placed in a vise. The pattern is removed from the lathe and turned around and screwed on the face plate, the screw entering the wood at the bottom of the hole previously turned out for the lower core print. In this way the hole for the upper core print can readily be bored without moving or jamming the pattern fastenings in a vise. If desired the pattern may be chucked and the second hole turned out.

Fig. 31 shows the methods of turning the core prints. A block $1\frac{1}{4}$″ square and 4″ long being used. The block is turned between centres and enough stock will be left at each end so that the centre marks can be removed. The core prints are to be glued into the pattern which should be held in a vise or a clamp until the glue is thoroughly hard. The two core prints must, of course, be exactly in line. No difficulty should be found in accomplishing this if the hole for the upper core print is carefully bored.

The core box for this pattern will be taken up in the next number together with other simple patterns requiring core boxes.

JOINTS IN WOOD-WORKING.

FRANCIS L. BAIN.

I. Edge Joints.

There is, perhaps, no one thing in amateur carpentry and joining which causes so much faulty work as the lack of a proper knowledge of how to make and when to use the various joints which are common to this class of work. It is, therefore, intended that the series of articles to be published under the above heading shall, if possible, render some assistance to those who may have had difficulty in securing satisfactory results when engaged in any work involving the making of joints, also to those who may not be familiar with the different joints used by carpenters, cabinet-makers, pattern makers, etc.

Only those joints that are in every way most practical will be considered, and these will be classified under two sub-headings: edge joints (for attaching edges of boards or planks together) and joints for attaching ends together.

It is necessary that, when planing stock, any appearance of a "twist" or "wind" be removed and the surface carefully "trued up". It may also be as well to mark each surface as soon as it is finished flat and true, in the order in which it is completed, as 1, 2, 3, etc., 1 referring to the broad surface; 2, to either one of the adjoining edges, which should be placed exactly square with 1; 3 to the remaining edge after the width has been obtained from 3, and 4 to the remaining broad surface after the thickness has been obtained from 1. These suggestions simplify directions very much if they are correctly carried out.

EDGE JOINTS.

The first joint which will be considered is the plain "glue joint", also called by some the "butt joint". It is the simplest and the easiest to make. Assuming that in all cases the stock has been prepared according to the rules given above, the pieces to be glued together should be warmed a little, either in a lumber kiln or near steam pipes if possible; then the edges should be carefully and quickly covered with hot glue. (Cold glue will answer if it is not convenient to get the hot.) Place one of the pieces in a vise, glued edge up,

and putting the other piece on top of the first so the glued edges meet, rub the upper piece slowly and steadily back and forth lengthwise over the under one until any surplus glue is forced from the joint. All that now remains is to apply either hand-screws or cabinet-makers' clamps, then allow the stock to stand until the glue is thoroughly dried or "set". Quoting as authority one who has been engaged in different branches of cabinet making, stair-building, etc., for nearly thirty years, an ample time allowance when using hot glue is $\frac{1}{2}$ to $\frac{3}{4}$ of an hour for drying for every $\frac{1}{2}$ in. of thickness in the stock being glued together.

The above joint can be used to good advantage in any position except where there is excessive exposure to the action of moisture of any kind. In the latter case the union of various pieces of stock would be accomplished by the use of the "splined" or "groove and tongue" joints, which will be described in subsequent chapters

LANTERN SLIDE MAKING.

R. G. HARRIS.

VI. Retouching Lantern Slides — Spotting — Varnishing — Masking.

Before lantern slides have the finishing touches put to them in the way of spotting and binding, it is a wise course to put them through the lantern as soon as they are dry, to ascertain beyond doubt that the density and clearness entitle them to rank as finished slides. The constant and experienced worker can gauge with certainty the quality of his slides without seeing them projected, but the intermittent worker, especially during his novitiate, may well be excused if he fails to appraise correctly the quality of his slide. It entails very little trouble, as the slides can accumulate until a convenient quantity has been made to make it worth while arranging the lantern, and once the slides are seen to be satisfactory when projected the lantern slide worker is spared the annoyance of finding that he has finished and bound up a worthless slide.

Before masking and binding the slide it should be placed on a retouching desk and carefully examined by transmitted light for defects. Of course before making the slide the negative will have been carefully spotted and all possible defects removed as neatly as can be, but in spite of this the lantern slide will require attention at the spotter's hand from defects that have made their appearance during its manufacture. As a rule, the most that can be done in the way of retouching to a lantern slide is the removal of transparent spots by filling up with color. Knife work or any process that disturbs the surface of the film is inadmissible, as, unless most skilfully done, it shows unpleasantly on the screen. It is possible in certain cases to rub down dense portions with methylated spirit, in the same manner as is usual with negatives. But the instances when such a procedure becomes necessary do not often occur and are principally those in which it is absolutely necessary to make the best of a slide from a poor negative.

Spotting should be done by the aid of a very fine camel's hair brush and color. The precise color will depend on the color of the slide, but Indian ink and Indian red will, either singly or combined, match nearly all slides. A reading glass of low power is of very great assistance in enabling the operator to apply the color neatly to each spot. Furthermore, no light should reach the lantern slide from the back of the operator or he will fail to judge correctly the density of his spotting and find, when the slide is thrown upon the screen that all the spotting shows up darker than the transparency. The color should be kept of slightly less density than the opacity of the slide, and to ensure this being so, no light should reach the operator except that which is transmitted *though* the slide. The color should be used in quite a viscid condition, and tube colors are better than dry as the menstruum used in their preparation gives them a good working consistency.

As a rule, lantern slides on commercial gelatine plates are not varnished, nor does there appear to be much necessity for varnishing them, as the film

unlike collodion or collodio-bromide, is not liable to be readily damaged by friction. Varnishing certainly introduces the risk of applying specks of dirt and hairs to the film along with the varnish; on the other hand, if it is well done with a clean, hard varnish, immunity is secured from fungoid growths, which not infrequently make their appearance on gelatine films, however well defended and carefully stored. Personally, I always varnish a slide of excellent quality, more especially when it has caused me considerable trouble to prepare.

The following varnish has been spoken of in high terms far varnishing lantern slides:

Saturated solution of amber in chloroform	1½ oz
Pure benzole	1½ "
Gum dammar	1¼ "

When dissolved filter several times through cotton wool. Just warm the plate before varnishing and dry well over a gentle heat afterwards. It gives a bright, glass-like surface which is quite hard and does not become tacky.

A convenient and reliable varnish is made by dissolving one part of dammar in twenty parts of benzole. This is applied without heating the plate and dries with a brilliant hard surface. It is advisable in varnishing lantern slides to return the surplus varnish from the plate to a second bottle fitted with a filtering funnel and cotton wool; by so doing a stock of well filtered varnish is always maintained.

Selecting a suitable mask for any particular slide is a matter that must be left to the personal taste of the worker. It is, however, not quite the simple matter it looks at first sight. Time was when a rigorous conventionality assigned a perfect circle as the only possible shape for a lantern slide mask, then dome-shaped and cushion-shaped masks began to be seen, until at the present time the decision is left very largely in the hands of the slide-maker.

It may be said that, generally speaking, lantern slides should be amenable to the same reasoning and rules that good taste and culture apply to framing of pictures. The slide mask is, to all intents and purposes, the frame of the picture, and its shape should vary with the subject in the same way that the frame of a picture is made to do. Rectangular openings will always be in better taste than the cushion or dome-shaped openings, and their dimensions should be proportioned to the subject, a very useful all 'round size being a rectangle with an opening 2¾x2″ Circles are useful, but of a limited application, though for many scientific subjects they are invaluable. Commercial masks are, naturally, of stock sizes, and a well assorted selection of shapes will enable the worker to select one that will suit some subject better than it would another, but not infrequently subjects will present themselves that demand a specially cut mask to frame them most satisfactorily, and the lantern slide maker must needs become his own mask cutter.

The quickest and neatest way in which to make masks of any desired dimensions for odd subjects is to cut strips of varying widths from the best black needle paper. A supply of these strips may be cut for stock of standard widths, say, half an inch, one inch, one and a quarter inches, etc. The strips are afterwards cut up into lengths of three and a quarter inches, the size of the lantern slide. With a supply of these strips and four cut accurately, it is a very simple matter to make a rectangular opening of any dimensions by simply affixing them to the slide with a touch of gum arabic or any other adhesive that may be convenient. A pair of compasses will enable the several strips to be placed equi-distant, so that on completion the opening is perfectly true. This method is very much better in all ways for the amateur mask cutter than attempting to cut a rectangular opening in a sheet of paper.

The masks should be affixed to the film side of the slide with a touch of gum and then placed under even pressure to become set in a perfectly flat condition. If when making the slide the negative is placed on the camera with its film towards the lens, the lantern slide, when looked through with its film towards the spectator, will show the subject in its correct position. Before mounting the cover glass with the slide the title may be neatly printed on the black mask with Chinese white, utilizing the right-hand end of the mask for the purpose. On placing the slide in the lantern, if the title in Chinese white be placed towards the condenser the picture appears the right way about on the screen. If the title cannot be written in white on the mask, owing to the negative being reversed when the slide was made, the slides must bear white spot to indicate their correct position.

The cover glass having been cleaned and placed in position upon the slide, the slides have now to be bound together with the gummed strips sold for the purpose.

Binding a slide is one of those apparently easy photographic operations that is a perfect nuisance until some dexterity has been acquired. Vises, to hold the slide and cover glass firmly together while the gummed strips are being affixed, may be obtained from the dealers, and they probably help the beginner, but later on he will certainly find that his fingers are his best friends.

The gummed strips are sold either cut to the length of the slide, or in sufficient length to bind around the whole of the slide in one operation. For the beginner the divided lengths are certainly the more convenient. Four of these strips are taken, the gummed surface damped (not made wet) with a sponge and placed aside for a few minutes, gummed side uppermost, on a piece of thick felt cloth. The slide and cover glass are now taken between the index finger and thumb of each hand and their lower edges placed in the centre of the gummed strip, downward pressure on the soft felt surface sufficing to attach the strip firmly to the lower edges of the slide and cover glass. On being reversed so that the edges bearing the gummed strip come uppermost, the strip can be pressed in contact with the sides of the slide and cover glass by the forefinger and thumb of each hand. The remaining sides of the slide are bound in the same manner. This is the simplest manner known to me of binding lantern slides, and I have tried a great variety, both with vises and without.

Some years ago the Photographic Club introduced a system of marking lantern slides to facilitate their being placed in the lantern so as to show correctly on the screen. It consisted of affixing two white discs of paper to the slide, on the side that gave the subject its correct rendering as regards right and left handedness when viewed as a transparency. These discs are placed at the top of the slide when it is held upright. If the slide is placed in the lantern with these discs down and towards the condenser, the view or subject is shown upon the screen correctly as to right and left-handedness. The American system of marking lantern slides is to attach one disc, known as a thumb-label, at the lower left-hand corner.

TELEPHONE CIRCUITS AND WIRING.

ARTHUR H. BELL.

II. Lines with Magneto Generator.

With the apparatus described in the last issue the amateur is enabled to establish communication between two points not more than a few hundred feet apart. In beginning this chapter we will briefly outline a circuit (Fig. 6) introducing a simple induction coil for increasing the talking efficiency, but the scope of this phone is, like its predecessor, limited by the signalling equipment; in fact, with a good transmitter and coil it matters little in the talking whether parties are a few yards or a few miles apart, line conditions being all right, for the transmitter utilizes but a small current in operation. From this we may deduce that the amount of battery current necessary in signalling over long distances would not be beneficial to a transmitter calling for 2 to 4 volts and considerably less than 1 ampere, also that the introduction of resistance in the transmitter circuit would be unsatisfactory as a current cut down.

This leads us to the more modern equipment often styled the "magneto system"; a magneto being an electrical generator of the alternating type, mounted in a small wooden box and capable of delivering a voltage ranging from 50 to 70 or more, according to its size and the speed of rotation applied at the hand crank. Such a device cannot be used with a battery call bell, but requires a polarized ringer designed to accompany the generator. When the ringer is connected by two wires to the magneto generator and the crank rotated briskly, the signal will be given even though the instruments are several miles apart. Thus, in using these devices, the number of cells of local battery need never be more than two at

either end.

Relative to magneto equipments, the price of standard machines is so low that no similar contrivances could be completed at home for anywhere near the price, hence a description of both

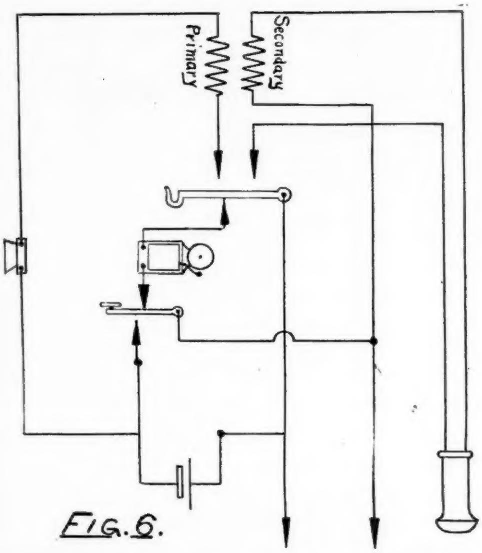


FIG. 6.

bell and generator construction is not essential at this point. Induction coils for the talking circuit may also be purchased at about wire prices.

Fig. 7 shows in detail a circuit for one end of a bridging magnetio private line. In this diagram the bell and generator are shown separated one from the other, that the equipment may be fully understood but it, is generally the custom to purchase these set up in one box, the hook for the receiver being at one side, the crank handle on the other and the gongs and transmitter on the front, which is usually a cover to the box, and with two binding posts at the top to take the line wires. Batteries for the transmitter may be placed close at hand or stored some distance away and connected by insulated wires with the circuit.

In this diagram it will be noticed that with the receiver on the hook, a ring from the other end operates the signal bell. In ringing with the generator the pressure of the hand in rotation causes a circuit to be completed by the armature spindle bearing upon a spring and ringing your own bell as well as the distant one. When the receiver is removed from the hook the two lower contacts are made common with the hook, thus putting the receiver, transmitter, battery and coil upon the line for talking. Should this private line comprise more than two stations the bell coils of such instruments as are not in use are, of course, across the line, but owing to their form of construction and high resistance, they act as a choke to the voice currents and keep them on the line.

Different manufacturers employ various methods of wiring bridging telephone sets, each having some special qualification. The one here shown is common to a number of good systems, and should be closely studied by the amateur. Nearly all dealers supply customers with working diagrams when same are requested.

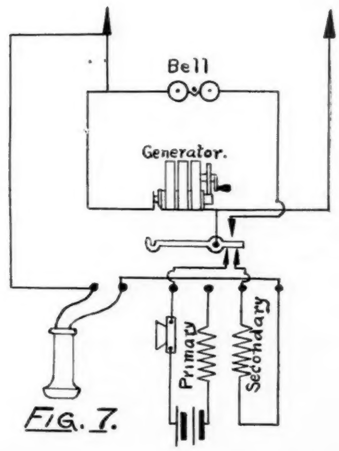


FIG. 7.

Wires for outside construction may be of No. 12 galvanized iron wire, and as conditions for line work vary in different localities, the subject of lines passing over other than one's own territory will be treated in another chapter. On one's own property wires may be run circuitously through trees to avoid setting poles, but care must be taken to insulate the wires from all substances likely to give trouble. Insulators of glass to fit on wooden pins and porcelain affixed with screws or spikes are commonly used.

In running such lines separate the wires a full foot from each other, using care that a sag in the one does not throw it against the other or against some conductor that will cause trouble.

Where wires enter buildings some certain means of protection must be provided. Carbon and fuse arrestors are for sale by dealers in tele-

phone equipments generally, and may be depended upon to protect both instruments and property when well installed, from foreign currents upon the line. Lightning, which is oscillating in character and of enormous voltage, often strikes contiguous to telephone lines and a certain amount of the charge passes to the arresters, where it enters the ground without damage. No device has been provided that will ensure safety should lightning discharge directly upon the circuit near the instrument. The modern carbon arrestor and fuse block, however, may be depended upon in practically all cases except the foregoing, and as types and methods of installation vary, a diagram will not be presented here, that being usually supplied by the dealer.

All protecting devices, however, are placed just inside the building as near the point of entrance as possible. The outside line ends, usually on two glass or porcelain insulators, supported on wooden or iron brackets. The wiring from this terminal to the lightning arrestor inside the building should be heavily insulated with rubber and take separate holes where entering. The usual form of arrestor has five binding posts — two for the line, two for the instrument side, and one additional to which is connected a heavy wire, known as a ground wire of value only as a discharging circuit to earth for foreign currents breaking in on the line and causing the protecting device to operate. At no time does this ground wire enter info the talking circuit.

In the next chapter will be given a diagram of a stmple interior outfit with several stations wired suitable for room to room communication.

TWO ELECTRICAL FORMULAS.

There are two formulas for electrical measurements which every amateur electrician should memorize. They enter into all sorts of calculations in telephone, telegraph, electric light and general experimental work.

First: — The combined resistance of two parallel circuits, may be found by multiplying the resistances together, and dividing by the sum of these resistances. Where there are several circuits in parallel, any two are treated thus, and the result combined in the same way with the resistance of another circuit, and so on to get the final resistance. For example: — The amateur has planned a circuit as in Fig. 1. One shunt measures 50 ohms, and the other, 100 ohms. The combined resistance will be equal to 50×100, $\div$ by $50 + 100$, $= 33\frac{1}{3}$ ohms. If the amateur

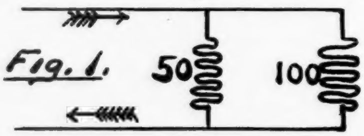


Fig. 1.

should conclude to add on another shunt of say 2 ohms, (see Fig. 2,) he should consider the problem resolved into two factors, the $33\frac{1}{3}$ result of the previous calculation, and the new shunt of 2 ohms, $= 33\frac{1}{3} \times 2, \div$ by $33\frac{1}{3} + 2$.

Now it becomes evident to the amateur, that, knowing the combined resistance of these shunts, he may calculate by Ohms law ($C = E \div R$,) just what effect this combined resistance will have on the amount of current. Yet it must not be presumed that any one of these shunted resistances is to carry more than its prescribed portion of the current. And to ascertain just how many amperes each shunt is taking we must follow a rule that, in such a divided circuit, each shunt carries a proportion of current, inversely proportional to its resistance.

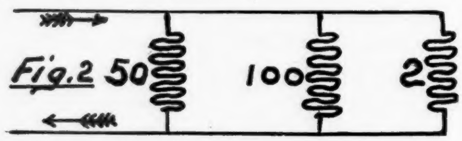


Fig. 2

In explanation, note down for each branch or shunt, the reciprocal of its resistance. Then reduce these fractions to a common denominator, and add the numerators together. Use this sum of the numerators for a new common denominator, and the original individual numerators as numerators, and the resulting fractions will show what part of any current that may be in use will pass through any one of the shunts. For example, using the shunts of the previous example: $\frac{1}{50}, \frac{1}{100}, \frac{1}{2}$, common denominator, is 100. New fractions become $\frac{2}{100}, \frac{1}{100}, \frac{50}{100}$, $2 + 1 + 50 = 53$. Following the rule above given, we calculate that the first shunt of 50 ohms carries $\frac{2}{53}$, the second or 100 ohm shunt, carries $\frac{1}{53}$, and the last, or 2 ohm shunt, carries $\frac{50}{53}$. The total, or $\frac{2}{53} + \frac{1}{53} + \frac{50}{53} = \frac{53}{53}$ or unity.

HIGH FREQUENCY PHENOMENA.

H. E. DILL.

Principles of Coil Construction — Wehnelt Interrupter.

The Ruhmkorff coil, with its many turns of fine wire coiled in sections and combined together to form a secondary, has been so long an indispensable part of a well equipped electrical laboratory that I shall make no attempt to describe in detail all of the principles of operation, but refer the beginner to one of the numerous elementary works upon electricity. It is advisable, however, to point out the basic laws as discovered by Faraday and others seventy years ago, in order to make clear the general arrangement of all coil windings.

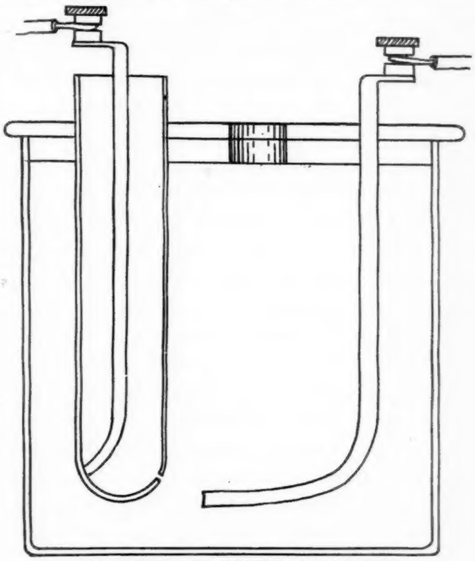
First of these principles is where you have two distinct circuits contiguous to each other, but not in contact, and by exciting an electric current in one of them instantly induce, that is, produce by induction, an electric current in the opposite direction in the other. And if the current in the originating circuit is suddenly interrupted, a secondary current will momentarily be induced in the secondary circuit, but in this case in the same direction as the first current. It follows that if we alternately open and close the primary with some rapidity we shall induce in the secondary circuit a current continually changing in direction. As to the characteristics of these alternations further observations will be made later.

The second principle relates to the rapid movement of a magnet in proximity to a conductor or of a conductor in proximity to a magnet—developing an electric current in the conductor.

Thirdly, a bar of iron may be rendered powerfully magnetic by being placed in the vicinity of an electric current. This magnetism will continue while the iron remains under the inflnnence of the current.

In a device possessing these features, namely, a soft iron core; a coil of wire encompassing the core; a source of current to pass through the coil, thus energizing the core; a secondary coil of wire insulated from but encircling the primary winding and the core; a means of interrupting at will the source of the primary current,—these are the factors in induction coil building.

The actual E. M. F. of the primary circuit remains practically unaltered, but the E. M. F. of the resulting secondary current is greatly increased from several causes. One is the great length of wire in the secondary, coiled in many turns in the field of magnetic influence. Second,



WEHNELT INTERRUPTER.

the rapidity of interruption constantly produces a magnet in proximity to the secondary winding and as quickly takes it away, and this rapid magnetization and demagnetization of the core intensifies the current already intensified by the cutting of lines of force. It is to be remembered that this continual making and breaking of the primary circuit causes the secondary to be further intensified by the alternations of current.

In coils bearing condensers in connection with core-energized interrupters, the condenser plays an important part in intensifying the secondary circuit, for as previously explained, the

induced alternate currents depend on the make and break of the interrupter, but it is also a fact that the breaking of the primary circuit momentarily produces by induction a slight extra current in the same direction, in itself a phenomenon called self induction. This self-induced current is absorbed by the condenser at the moment the primary circuit is broken, only to be discharged a moment later through the primary coil, thus creating a current in the opposite direction to the battery current, and thus assisting in demagnetizing the core and greatly adding to the efficiency of the coil.

Having now explained the method of intensifying a source of current by induction, I will describe one type of interrupter, whose invention some years ago opened a new era in high frequency work. I refer to the Wehnelt or Electrolytic break, for which is claimed interruptions as high as 2000 per second when operated direct connected with incandescent mains.

As far as personal experience points out, when used with ordinary coils this interrupter varies from 250 to 1500 per second, depending upon the size of the electrodes (to be described), the inductence of the circuit and the value of the E. M. F. With specially designed coils, frequencies far in excess of these have been reached in the secondary discharge by using special capacities in that circuit. The subject of calculating these frequencies is now a foremost problem in this branch of science. The pitch of an interrupter is a rough range or measure of its breaks, and it is reasonable to suppose that its range of sounds is the limit of its rate of break, but where the variance of sound precludes estimate, by what are we to be governed? It is not advisable at present to describe the complex devices for frequency measurement, because many of the resnlts have been questioned, although the rotating mirror method and calculations based on the inductance and capacity values have demonstrated that sinusoidal currents with a frequency of 400,000 cycles may be produced by special and elaborate apparatus.

In the older forms of vibrators using platinum contacts, primary voltages of 100, or more, gave but meagre results owing to the heating and blackening of the platinum and the low rate of interruption, but with the introduction of the Wehnelt there was opened a new field of research.

This interrupter, a sketch of which is here given, consists of a glass jar, filled with water slightly acidulated with sulphuric acid. In this solution is immersed a lead plate and an insulated platinum point, the plate being connected to one terminal of the electric current supply and the platinum point to the other. A suitable adjustmént of the two electrodes gives rise to current interruptions of a high and varying frequency.

Because of the effect of current action on the platinum tip, and being unable to find a less expensive and equally satisfactory metal, many experimenters were led to substitute in its place a small glass bottle having an extremely small hole drilled near its base. In this bottle was placed a strip of lead which was connected with one side of the source of current.

The conductivity of the electrolyte was not only benefited by the addition of more sulphuric acid and a small quantity of magnesia sulphate to the water, but the number of interruptions seemed also to be increased and operations started at a lower voltage.

As to its general adaptation to amateur work, it is well to note that it is generally the custom in designing a high potential coil to consider frequency of interruption and insulation together for the penetrative effect of a rapidly broken magnetic field may imperil an insulating medium ordinarily secure under a low rate of interruption. Oil used as a dielectric, saturates the windings and being liquid becomes self-sealing should by chance a stray discharge pass from one part of the secondary to another. Hence the use of transel oil and similar oils in many grades of transformer work.

The Niagara Falls electricial output is so enormous, that nearly one-half of the horse power required to operate the vast amount of machinery within the limits of Buffalo City comes from this one source. And yet the present system of supplying electrical energy from Niagara Falls to Buffalo was inaugrated barely five years ago.

The system of identification by finger prints, which was introduced into use recently, has been used in Korea for many centuries in the deeds for the sale of slaves. The slave was required to place her hand—all the slaves were women—upon the sheet of paper on which the deed was written, and the outlines of the fingers and thumb were traced, after which an ink impression of each of the fingers was taken.

AMATEUR WORK

77 KILBY ST., BOSTON

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JULY, 1904.

Sport, pastime, enjoyment seem to engross the minds of many of the young men of today to the almost entire exclusion of anything else. While these are right and proper, even beneficial in their way, there are limitations, and these limitations require that the probable future vocation should receive consideration, and a reasonable portion of time be given for preparation toward it. In view of the increasing number of capable young men in situations unsatisfactory to themselves, a brief study of the causes leading thereto is instructive. In general, it will be found that during youth and early manhood no great attention was given to obtaining an adequate knowedge of some trade or business. Therefore the business career is commenced with no substantial foundation. Adverse circumstances, in such a case, are productive of disastrous consequences, the worker not having attained to that skill, or acquired the knowledge for which there is always an unsatisfied demand.

It is, therefore, of decided importance to the future prosperity of every youth that he, early in life, forms definite conclusions as to the general trend of his future business career, and thenceforth utilizes every available help which presents itself. Only in this way can he reach the position of being better than the *ordinary*; that is, the man who is wanted, instead of wanting.

The man who knows something thoroughly, can do something well, is the man who arrives.

During the months of July, August and September an extra one-subscription premium will be given to anyone sending in three subscriptions. As many of our readers will, during this time, be enjoying their vacations, they should find it easy in this way to obtain some valuable additions to their tool kits.

We will also during these months give to anyone sending $1.25, a year's subscription to AMATEUR WORK and a choice of either of the following books:—

Norrie's "Induction Coils" or Avery's "A, B, C of Dynamo Design." The first of these books contains much of value to those interested in coil making; the latter book is undoubtedly the best presentation of the elementvry principles of the subject to be obtained and just the book for amateur dynamo and motor builders.

The "poison squad" utilized by Dr. Harvey W. Wiley, chief chemist of the American Agricultural Department, in experimenting with adulterated food products, was disbanded on May 21. The twelve young men have eaten nothing but adulterated food since early in January. Everything has been more or less tinctured with salicylic, sulphuric or benzoic acid. The experiments were a continuation of those begun a year ago to determine exactly the actual effect of food preservatives on the human system. Such acids were used as are employed by domestic and foreign packers in preparing meats, butter and other products for shipment. The acids were at first placed in the food, but subsequently given in capsules. The most accurate record was kept of the men's condition. It is said some of the men have materially deteriorated in health as a result of the acids administered to them. All are said to have been affected by the drugs used as food preservatives. No details as to results will be given out until a formal report is submitted to Congress.

A narcotic bomb has been invented by a surgeon in the Austrian army. The bomb, which may be fired from any gun, has a time fuse, and when dropped among a regiment of the enemy will not explode, but will fill the air with narcotic gases strong enough to make 2000 men unconscious for several hours. While in this condition they may be captured, and when they wake up they will feel no bad effects of their experience beyond a slight headache.

The whirling winds of Arabia sometimes excavate sand pits to the depth of 200 feet, the rim usually being three times that length in diameter. A sand pit thus may be entirely obliterated in a few hours and another excavated within a short distance of it.

HOW TO BUILD A 12-FOOT ROW-BOAT.

CARL H. CLARK.

A boat of the type and size to be described is a very convenient boat for rowing on a lake or on the salt water, and also makes a good tender for a yacht. The dimensions, 12′ long by 4′ wide, make a boat which, while easy to row, is yet wide enough to carry well and be very stiff.

The usual method of recording and transferring the lines of a boat or yacht is by a "Table of offsets" such as is here given, and the amateur boat builder should accustom himself to working from it, as it saves him the trouble and inaccuracy of scaling from the printed drawing. The figures given are taken by the designer from his original drawing and are, of course, more accurate than any which the builder could take from the small printed plans. The water lines, or lines parallel with the base line, are 3″ apart, while the cross sections are 3′ apart. In Fig 3 it will be noted that the water lines cross all the mould lines and the distance on each water line from the contral line to its intersection with the mould line, is the offset given in the table. The figures along the top of the table correspond to the numbers of the moulds in Figs. 1 and 2. The two top lines marked "height of sheer," and "height of rabbet," give the height of the sheer and rabbet above the base line on each mould. The lines below give the half breadths of each mould on each water line before refeired to. For instance, to find the half breadth of mould No. 2 on waterline No. 3, the vertical column numbered 2 at the top, and the horizontal row headed No. 2, 3 at the side are each followed until they meet and the required offset, 2, 3¼″ is found.

FIG. 4. LAYING DOWN TABLE.

	1	2	3	Stern
Ht gunwale above base	2′-1 ″	1′-10½″	1′-10⅝″	2′-0⅝″
" rabbet " "			-0⅝″	9 ″
½ breadth-gunwale	1′-7 ″	2′- 0 ″	1′-10½″	1′-4½″
" " " W. L. 6	1′-6⅝″	2′- 0 ″	1′-10½″	1′-4⅝″
" " " " 5	1′-6⅛″	1′-11⅞″	1′-10⅛″	1′-2⅝″
" " " " 4	1′-5¼″	1′-11⅜″	1′- 9½″	9⅜″
" " " " 3	1′-3⅝″	1′-10⅜″	1′- 8¼″	-⅞″
" " " " 2	1′-0⅞″	1′- 8⅛″	1′- 5⅜″	
" " " " 1	8½″	1′ 2⅞″	10⅛″	

The shapes of the moulds should be laid off first, each on a separate sheet of thick paper. A centre line is drawn, and also the correct number of water lines 3 ′ apart at right angles to it. The proper offsets are then read from the tables and set out on the water lines, being laid off on both sides of the centre line to obtain the complete outline of the mould. At the foot it is made the same width as the keel, 1¾″, and the upper end is laid according to the height from the line headed "height of sheer," and of the breadth given in the line headed "breadth of sheer." Through the points thus obtained, a smooth curve is drawn with a limber batten. It may not be possible to make the line pass exactly through all the points, an error of ⅛,′ or so being allowable, but it should be a fair average of all the points and must, in any case, be fair and smooth. The curve thus obtained is the shape of the boat to the outside of the planking, but since the mould fits inside of the plank a new curve must be drawn inside of that just drawn and distant from it an amount equal to the thickness of the plank, in this case ½″ This new outline must also be 1¾″ wide across the foot, and is the shape to which the mould is made. The moulds are made as in Fig. 5. of rough pine or spruce, but well braced and strong. The centre line is marked across, as shown. for use in setting up. The stern is worked out of a piece of oak or mahogany 1″ thick. The shape shown being that of the after face, the edges must be left with a considerable amount of bevel which is later trimmed down so that the plank will lay on evenly. The outline on the stern board should be cut only as high as the gunwale line, and above that the board should be allowed to extend out over the plank.

A pattern should also be made of the stem along the rabbet line, and also of the deadwood at the stern end. The framing of the keel, stern and deadwood is shown in Fig. 6. The keel is 2½″ deep and 1¾″ wide, tapered at the ends to 1½,′ wide. The stem is 1½″ thick at the rabbet line and is cut from a natural crook knee. The shape of the rabbet line is marked on from the paper pattern, and the outer and inner outlines are each 1½″ away from and parallel with the rabbet. At the rabbet line a rabbet is to be cut, as shown in the section of the stem, to take the ends of the plank. It can be cut only approximately now and trimmed out later after the stem is set up. The stem is fastened to the keel, as shown, with galvanized iron rivets. At the after end of the keel the stern post and deadwood are to be set up. The stern post has a tenon cut on its lower end which fits a corresponding mortise in the end of the keel, a pin being driven through. The angle of the stern post must be carefully adjusted and correct. The deadwood is the same thickness as the keel and is shaped according to the pattern already gotten out, the rabbet line being marked on both sides of it and the upper edge being cut ⅝″ above and parallel with the rabbet. It should be noted that the rabbet being the joining line between the surfaces of the plank and the keel, is about ⅞″ below the top edge of both keel and deadwood in order that the inner edges

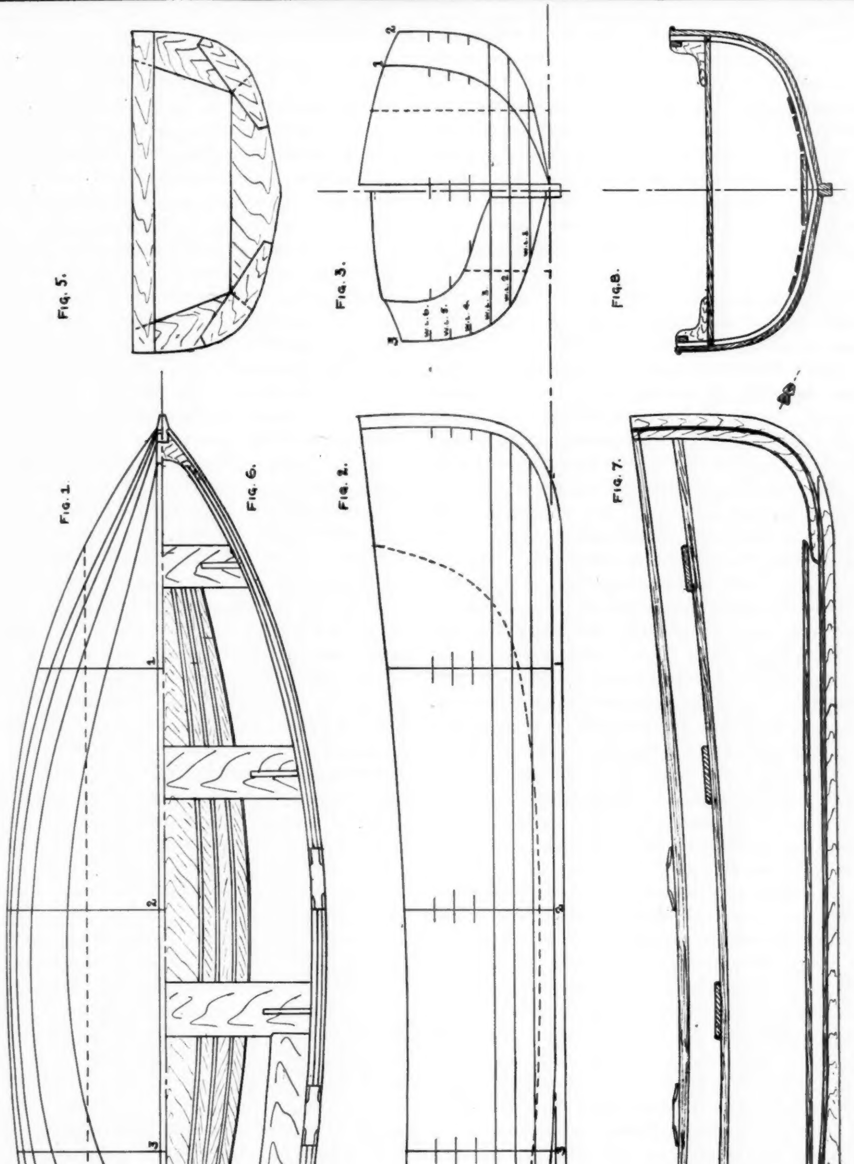


Fig. 5.
Fig. 3.
Fig. 8.
Fig. 1.
Fig. 6.
Fig. 2.
Fig. 7.

of plank and keel may be even. The deadwood is fastened in the angle between the keel and the stern post with rivets and screws. The stern board it set into the stern post as shown. The rabbet line is extended up across the stern post, and the stern board is set down to about ⅝" of the rabbet line, so that when the outer surface of the ½" plank is even with the rabbet the inner surface will lie upon the stern board. Care must be taken to set the stern board level and also square with the keel, when it may be fastened into place with rivets.

In setting the boat up for planking, the keel is supported about 18" from the floor and the stem and stern firmly braced in the correct position. The moulds are then set up in their correct positions. Moulds Nos. 1 and 2 are set with their after faces on the mould point, and No. 3 with its forward face at the mould point. The keel should be supported under each mould, and each mould braced firmly against the keel so that there will be no tendency for the mould to rise out of place under pressure. A line stretched from the centre of the stem to the middle of the stern board will aid in getting the moulds up right, and a carpenter's square will help to get them square with the keel. A batten, or thin strip of board is now laid on the moulds and stern board and the latter bevelled off until it lies flat upon them. The rabbet in the the stem is cut out until the ½" plank will bend around the moulds and fit even with the surface of the stem. The ⅝" of keel and deadwood just above the rabbet is bevelled off flat until it is square with the moulds, so that the plank will lie on the moulds and bed squarely against this bevelled edge. When the rabbet is trimmed out, a ½" hole should be bored in the rabbet at its intersection with the joint at each end of the keel and a pine plug driven in; this plug prevents the water from running along the joints and into the boat.

The plank is of ½" pine, well seasoned and clear, and in 14' lengths. If desired the boat may be planked up on frames in the ordinary manner, but this is not considered advisable at present unless the amateur has had considerable experience in boat building. The method to be outlined is one which is in common use for fishing boats and others. It is a very strong and tight method of building and very easy to construct. The planks are obtained in strips about 1½" wide, and if planed to order should be slightly thicker than ½", as some planing will be required to finish. The planks are put on one at a time and edge nailed, each one to the one below. The girths of each mould should be divided into the same number of parts, and each strip tapered from the middle towards the ends to allow for the decreased girth at the ends of the boat. The first streak is nailed to the keel and twisted into the rabbet at the stem; the ends of the lower streaks should be kept about horizontal and be allowed to run off to nothing on the stem and deadwoods. It is edge nailed to the keel with about 3" galvanized wire nails. These nails should be galvanized, small-head, finish nails, from 3" long down to 1½" and of small wire. They are driven about 4" or 5" apart.

Each streak is planed before putting on and tapered at the ends. The edges should be painted with lead before fastening. A small hole should be bored for the nail before driving, as in this way the nail can be driven straighter with less chance of splitting out. At the ends, where the strips are tapered, shorter nails must be used. Great care will be necessary in driving the nails not to split the strip below. The strips should also be nailed flat to the stern with about 1¼" nails. The strips are put on one after the other, and as the turn of the bilge is reached tne edges are slightly bevelled to give the curvature without causing an open seam outside. In driving the nails in one strip, care mnst be taken to avoid the nails in the strip below. At the stern, also, the plank is fastened to the stern board. As the plank is being put on, the remaining girth of each mould and the stem should be watched to be sure that the top strips are coming out even without its being necessary to work in any uneven pieces to fill up. It should be so figured that the top strip will come to the gunwale line as marked on the moulds and stem and fit up neatly under the projection on the stern board. The lower strips of the bottom will be found the hardest to put on on account of the twist at the bow, but by nailing first amidships and using one or two monkey wrenches to twist them into place, little difficulty will be found. The upper streaks should be started from the bow, working towards the stern. The edges of the strips should be kept as even as possible to have little to plane off. The ends of the strips should be cut off even with the after face of the stern board. Great care must be used that the first few strips at the bottom are kept in close to the stem forward as there is a tendency to form a bulge at thts point unless careful attention is given to it. The outside of the boat is now to be planed and smothed up. On the bilge enough should be taken off to make a round, smooth surface. After being planed the surface is to be rubbed down with sandpaper.

Although with this method of building, frames are not necessary it is thought advisable to work in a few "binners," or small oak frames about 1x2" and about 12" apart. They should run from gunwale to gunwale in one piece except at the ends, where they will need to be in two pieces. They are fastened to the plank with copper or galvanized nails; if the former, a burr should be shipped on before riveting. The moulds may now be taken out, watching carefully to note any tendency to spring out of shape. The boat should now be painted both inside and outside with a priming coat. Braces shonld be placed inside the boat to prevent any change of shape.

The gunwales running around on the inside of the frames even with the top of the plank, are of oak, 2x⅝". They run all fore and aft, being let into the knees at the ends, as shown in Fig. 7. The knees are natural crook about 1" thick, the overlap of the gunwale and knee being about 4"; the gunwale is tapered on the under side to the same thickness as the knees, and

knee, gunwale and plank are fastened with copper rivets.

The top edge of the stern board is rounded over, as shown in Fig. 3, and the stern post and keel are tapered down to 1¼″ at the keel. The stem is trimmed down to ⅝″ thick and the forward end of the keel is tapered to meet it. The top of the stem is cut off even with the forward knee and the face of the stem is fitted with a brass half round strip.

The seats are arranged as shown in Fig. 6. To support them a strip is fastened with rivets around on the inside of the frames about 7″ down from the top of the gunwale on each side running from stem to stern. The seats rest upon this strip. They are 8″ wide, preferably of hard wood, although soft wood may be used if the boat is to be painted all over. On the two middle seats two knees are fitted as shown, and on the forward seat, one knee. These knees are shaped to fit the curves of the side gunwale and are fastened to it by a rivet. These knees greatly stiffen the boat and prevent her warping. On the outside upper edge of the top a half round oak moulding about ⅝″ diameter should be fastened to give a finish.

In the bottom of the boat a ¾″ board about 9″ wide is laid in the middle flat, being tapered at the ends to fit the boat and supported by short blocks; it will need to be in two pieces to pass between the seats, and each part is held down by a button so that it may be removed for cleaning out the boat. On each side above the middle board, 3 narrow strips ½″ thick and 2″ or 3″ wide are fastened inside the frames, leaving a space of about ½″. To make these strips two of the strips before used should be bent to the required curve and nailed together edgewise, forming a wide strip with the necessary bend or camber. The edges should be bevelled, and they may be fastened in place permanently. The upper strips may be each shorter than the one below.

A heavy ringbolt is to be fastened on the inside of the stem jnst below the knee, to fasten the painter or mooring rope to.

A back board should be made to fit between the stern knees about 3″ away from the stern board. Its top should be rounded rather more than that of the stern board, and it is held in place by cleats on the stern seat and small chocks on the gunwale. The name of the boat is to be put on the back board.

A rudder should be made, shaped as shown, of a solid board with a cleat across the lower edge. The top of the rudder is cut down to have a shoulder, front and back, to support the rudder yoke, the top being rounded over with a hole for the pin above the yoke. The rudder is fastened on with braces and eyes such as are sold for the purpose.

To support the rowlocks, oak blocks about 8″ long are fastened on the top of the gunwale and top strip with screws. The best position for the rowlock is a matter of trial, but 12″ from the edge of the seat is right for the average person.

The boat should be painted two or three coats inside and out before putting into the water. It is suggested that the stern board seats, gunwale and half round moulding be finished in varnish. No calking is required, but any small cracks may be filled with putty after she is rubbed down with fine sand paper.

The boat thus built will remain tight for many years; it should never be calked, but after being stored for a season should be painted and allowed to swell up in the water when she will become tight again. The oars for this boat should be 7½′ to 8′ long.

SOLDERING.

H. M. CHADWICK.

I. Plain Soldering.

The articles necessary for doing ordinary soldering are the flux, the scraper (an old knife will answer very well for the latter) the iron and the heater.

The Flux. This is a fluid made from acid that must be used to coat all surfaces to be soldered. Good soldering fluids may be purchased at the hardware stores, but as satisfactory a one as any can be made by pouring a tablespoonful of hydrochloric acid over a piece of zinc the size of a half dollar. Let the acid act until the zinc is taken up. Strain the resulting fluid, which is zinc chloride, and put it into a bottle with a glass stopper. It will keep a long time. Avoid bringing the fingers in contact with the flux, as it makes the skin sore.

The Iron. The soldering iron is realy not an iron at all, but a piece of copper fitted with a handle. For ordinary work, use an iron about 3″ long ⅞″ to I″ in diameter. Smaller ones are good for very small work but will not hold the heat long enough to do a good job on a seam several inches in length.

Make a cleaning pad from a pieces of old cloth folded into several thicknesses and tacked to a board.

To prepare the iron for use, file the end for about an inch from the point bright and smooth and heat it very hot, but do not let it get red.

Wipe the hot iron clean on the cloth, dip the bright end into the flux and apply it to the end of a stick of solder. If the iron is hot enough the solder will melt

and stick to the iron. Let a few drops fall to the cloth and rub the iron around in the molten solder. This will *tin* the implement thoroughly.

The Bunsen burner is a good thing over which to heat an iron, provided there is gas in the house, but a coal fire does very well, though it is not so clean.

Suppose, now, one wishes to mend a hole in a tin pan. Scrape a surface around the hole equal in area to that of a dime, using an old knife or, perhaps, a piece of emery cloth, being sure to remove all grease and dirt. Do not even rub the place with the fingers after getting it clean. Apply a little flux with a brush or a piece of clean wood. Cut a piece of solder from the stick the size of a small pea and place it over the hole. Next, rest the iron, well heated and tinned, on the cold solder, and the latter will melt at once and spread over the cleaned surface.

To prevent the solder from running through the hole, rest the pan on a flat piece of wood, thus bridging the opening, Another and better way is to smear a small quantity of plaster of Paris on the under side of the pan.

Agate ware can be mended in this manner as well as plain iron and tin. Chip off the agate covering with a few careful blows from a hammer or the blunt end of a heavy file. Scrape the metal clean and solder as directed.

To solder a seam, such as the lapping edges of a tin box, proceed as already stated, but tilt the box slightly so that the solder will tend to run downwards and fill the seam. The molten solder will follow the iron as it is drawn along the crack, provided the iron is hot enough and well tinned.

Never cool soldered articles by dipping them into water. Solder sets better if allowed to cool in the air. If the molten solder collects in little balls and refuses to spread over the cleaned surface, there is dirt or grease present. If the solder melts but does not run and collects in pasty bunches, the iron is not hot enough. If the melted solder refuses to follow a good hot iron, then the iron is dirty and had better be filed and retinned, or at least rubbed on the cloth.

The novice will undoubtedly waste much solder, in spite of careful effort, but this fact should not discourage him, as a little practice will teach him to avoid this error. The next article will treat of the blowpipe and Bunsen burner and their uses in connection with soldering.

CASTING IN SOFT METALS OR ALLOYS.

The casting of metals having a low fusing-point is one of those things which is well within the reach of the amateur or professional caster, provided he has certain of his alloys made for him, and he can have a range of temperature for his metals and alloys from about 96° Fahr. to about 1,500° Fahr., and for melting these an ordinary plumber's furnace or a portable forge will provide sufficient heat. As to hardness, these metals and alloys can be had from the softness of the softest solder or tin to that of cast iron, and with tensile and bending strengths up to moderate steel, and they will stand friction well, particularly when properly lubricated. Great heat they will not stand, as a matter of course; but many will stand from 250° to 400° Fahr. without injury. The cost is that of brass and bronze, if the alloying is done at home; but of course, when made out, the cost of alloying has to be considered.

Where alloys are made it is usual to melt the most refractory metal first and then to add the others according to their fusing-points, afterwards pouring into bars or slabs, remelting to secure uniformity, and then running into bars or narrow slabs, the latter—poured on edge—being about 3″ wide and ½″ thick for convenience of quick melting at a moderate heat.

The metal referred to in this paper can be cast in iron moulds, in plaster and fine Bath brick moulds, or in ordinary sand—weak loam—moulds; the system of moulding with sand or plaster moulds being the same as for brass, except that the sand moulds should not be rammed so hard as for brass. The harder metals and alloys should not be cast in closed iron moulds; but they do well in "strip" or "ingot" moulds open at top, previously dressing the moulds with whiting or plumbago; in trade foundries each one having its own preference.

Probably the amateur would find it easier to use plaster and Bath brick moulds, as with these there is only the minimum of difficulty. In the first place, Bath brick is reduced to powder when perfectly dry, and after passing the powder through a 30-mesh sieve, it is mixed with fresh plaster of Paris at the rate of about two-thirds plaster and one-third Bath brick, passing the mixture through a 16-mesh sieve to insure thorough mixing. Plaster by itself is not sufficiently refractory, but when mixed in the proportions mentioned it will answer for any metal with a fusing-point no higher than brass, providing the bulk is not too large. The moulds should be made in halves, and provision must be made for pouring the metal and the escape of air, on which poinis the operator must use his judgment; but as the alloys mentioned pour "dead," there is little difficulty so long as the air has sufficient outlet. When made, the moulds should be thoroughly dried, and before pouring they should be clamped together and weighed down to prevent lifting. Damp moulds are liable to explode and to cause bad castings; therefore the matter of dryness should be

closely studied. Where the castings are to be turned or otherwise machined, facing is not required, but where extra smooth castings are needed the moulds should be dusted with fine plumbago—not stove polish—before they are quite dry, and if this is brushed over with a soft brush and the moulds blown out with a pair of bellows when dry, the castings will have a fine face. Ground steatite may be used instead of plumbago, if preferred.

The metal or alloy should be melted until it is fluid; but no excess of heat should be allowed, and when it is being run into the moulds it should be poured steadily and with quickness; otherwise the moulds will run faint. Of course the crucibles should be skimmed, and no dirt or oxide allowed to get into the moulds.

An alloy that is easily melted and which has a strength approximating to that of steel, is composed of 75 per cent aluminium, and 25 per cent zinc, and this costs about 37 cents per pound for metal, and if the alloy is made for you, about 40 cents per pound. It is about half the weight of cast iron and, therefore, bulk for bulk, should cost about the same as brass at 8½d per pound. This alloy is largely used for toolmaking and other trade purposes, and wears well.

A harder alloy, which will stand a good amount of strain, is made from 66.66 per cent aluminium and 33.33 per cent zinc; but it is more of the nature of cast iron. This costs 32 cents per pound for metal, or is 86 cents per pound if made up into bars. As compared with brass in bulk, it runs out at a fraction less than the preceding. The writer has seen some very decent faceplates, angle-plates, and the like, made with this metal, but the preceding formula would give better results.

A third alloy may be mentioned in regard to strength, and which will bear some amount of hammering, and is composed of 65 per cent aluminium, 30 per cent zinc, and 5 per cent copper, the cost of the metals being about 32 cents, and bulk for bulk, compares with gunmetal at about 17 cents per pound, or in other words, castings in the alloy are about one-third cheaper than gunmetal.

Zinc broken down with copper—say, zinc 88 per cent, and copper 12 per cent—is useful for a great many purposes where strength is not required, and the alloy costs about 6 cents per pound, or, say, 8 cents, when made up to order.

When there is no crucible furnace at hand, the alloys mentioned above should be made by a brass founder or other alloyer, and the amateur should receive them in bars or small ingots ready for remelting. A fair price to pay for making alloys of a simple character is, roughly, a penny per pound, but large quantities would cost less. In no case will 100 pounds of mixed metals produce 100 pounds of alloy, as there are unpreventable wastes in making alloys. Loss differs somewhat with the metals used, and also with the skill of the alloyer; but in most brass foundries there is considerable skill shown in preventing undue loss.

With the alloys shown above it should be possible to work out any idea in metal except where temperatures over 300° Fahr. are concerned, and inventors would with these be able to secure absolute security, as they might very well make the whole of their models.

Fusible metals of a low fusing grade could be dealt with wholly in the amateur's workshop, and in melting for the making of alloys, if care be taken to melt the most refractory metal first and then add the other metals in accordance with their fusing-points, success will, as a rule, be secured. It is, however, not well to try to add zinc to copper until you have seen it done, as it splashes a great deal; nor should aluminium be added to a mixture of copper and nickel, unless there is plenty of room in the crucible, because there is a great risk of having the metal flow over into the fire and become lost. Care must also be taken in adding alkaline metals, such as sodium, potassium, and the like, to lead or tin in experimental work, as they explode violently unless they are in a very powerful carbon atmosphere—coal-gas, for instance—and as lead, tin, and other metals having a low fusing point make worse burns than iron or steel, the necessity for care is very apparent.

In conclusion it may be well to point out that when dealing with molten metal a bottle of pure raw linseed oil should always be available, as well as some white cotton thread waste or coarse lint, and *if* one unfortunately gets a splash of metal, the oil should be poured on freely. "Carron" oil—oil and limewater—is not so good for metal burns as pure linseed oil, according to the writer's experience. A great deal depends on condition, however, for while a heavy drinker, especially a spirit drinker, will have trouble with burns, a moderate man will find them dry up and heal without any application. The writer never worries about a few burns from molten iron or steel unless they are extensive, as they dry up very quickly; but a lead burn takes a long time to heal.—*English Mechanic.*

To obtain practically pure argon the following operation is carried out: The impure argon gas is passed from the cylinder through a tube of Jena glass containing 45 grammes of lime and magnesium mixture. It then passes through a second tube containing four troughs of nickel, in which are placed three or four grammes of metallic calcium in small pieces. Two mercury pumps are connected to the apparatus by a three-way cock. The first pump serves to produce an initial vacuum in the apparatus, and the second causes the circulation of the gas in the tubes, which are heated to low redness. The small quantities of nitrogen and hydrogen are retained by the calcium and the argon comes off in a practically pure state.

The preservation of creosoted piles is very striking. Some of those driven in 1876 as piers for iron bridges in the neighborhood of New Orleans are today in perfect condition, whereas the metal bridges which they support have now to be renewed.

HANDY HINTS FOR AMATEURS.

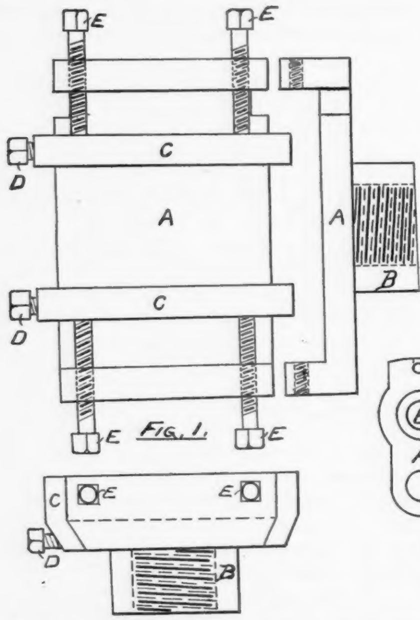
Contributions are solicited for this department, and for each accepted article the sender will be given the choice of any one-subscription premium from our premium offers.

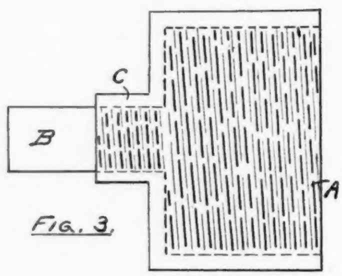
ATTACHMENTS FOR LATHE.

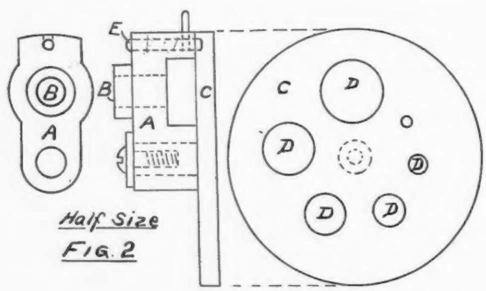
F. H. JACKSON.

Chuck for Lathe.

The chuck shown will be handy for holding nuts to face off, or for that matter, a great variety of pieces to be turned. *A* can be made of cast iron with projection *B* to screw on spindle, or it can be made of wagon tire steel $\frac{3}{8}$x2$\frac{1}{2}''$ and a hexegon nut, *B*, welded on and afterward topped out to fit on lathe spindle. The sliding pieces, *C*, fit over edge of *A*, which is beveled and has a set screw. *D*, in one end to clamp to plate. The screws,







E, (of which there should be several lengths) give the grip which holds the piece to be turned. It is advised to use screws *E* as short as possible, so that they will project no further than necessary, as they are great "knuckle dusters."

A chuck of this kind has been in use several years and has been found very handy on many occasions, and is well worth the time consumed in making.

Chucks Made From Pipe Reducers.

These chucks are very handy, as a piece of wood can be screwed into the socket at *A* and turned to hold any special piece to be turned. The part *C* is for $\frac{3}{8}''$ pipe size and should have a piece of round iron, *B* screwed in tight to be held in a self-centering chuck. All chucks should have same size at *C*, but the opening at *A* should be for $1\frac{1}{4}$, 2, $2\frac{1}{2}$ and $3''$ pipe size.

Drill Rest for Tail Spindle.

The holder *A* fits on a blank centre by hole *B*. Plate "*C*" is made with holes *D* of different sizes in this plate, as follows: $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{7}{8}$, and $\frac{3}{4}''$. The plate is held by a spring pin, *E*, which enters a small hole in back of plate directly over hole opposite end of tail spindle. The construction of the plate is so plain that it hardly needs any description. This size is suitable for lathes from 6 to $9''$ swing. The entire plate is made of cast iron. Care should be used in forcing the holder *A* on the blank centre at *B*, as it is held by friction.

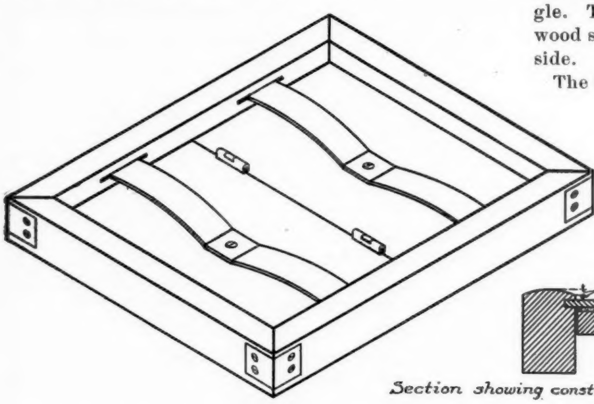
Water is nearly incompressible, but for all that, says Professor Toit, if the water in the ocean were not compressed as it is by its own weight, the level of the sea would be 116 feet higher than it is at present. In that case, 2,000,000 square miles of what is at present dry land would be submerged.

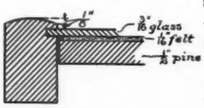
PHOTOGRAPHY.

PRINTING FRAME.

FRANCIS L. BAIN.

The frame described below will undoubtedly fill a long-felt want in the workroom of many amateurs, particularly those interested in photography, as it can be made quite cheaply. For those who prefer lightness rather than strength and long service in a printing frame, it is suggested that whitewood be used, while those who do not object to a little extra weight will find that cherry will far out-wear whitewood and give much better satisfaction generally.





Section showing construction.

The following materials will be needed, and in each case the measurements as given represent the *finished size* of the particular article referred to:

Sides—2 pieces kiln dried cherry 17¾" long, 2" wide, 1¼" thick. Ends—2 pieces kiln dried cherry, 14¾" long, 2" wide, 1¼" thick. Backs— 2 pieces kiln dried white pine, 11⅞" loug, 7 7-16' wide, ½" thick; 2 pieces felt, 11⅞" long, 7 7-16" wide, 1-16" thick; 1 piece glass 15¼" long, 12½''' wide, 3-16" thick. Springs—2 pieces spring brass 12½" long, 1½" wide, 1-16" thick; 4 pieces sheet steel 3" long, 1½" wide, 1-32" thick; 2 brass wood screws, round head, ½", No. 9; 8 bright iron wood screws, flat head, 1", No. 7; 2 brass hinges 1½" long, 1½" wide, when open; 8 brass wood screws, flat head (to fit hinges) ⅜" long.

After the four pieces of cherry have been planed to the required size, one broad surface, or side of each piece, should be numbered 1, and one of the narrow sides adjacent to this (known as the "joint side") should be numbered 2, then gauge a line on each No. 1 side which shall be ¼" from and parallel with, side No. 2; following this with another gauged line 3-16" beyond the first one (or 7-16" "from the joint side',). The space between these two lines should next be rabbetted out to a depth of ¼", either on a circular saw or wih a small chisel or router-plane, thus forming a groove into which the glass is to be fitted. The No. 2 edge of each piece is now to be rounded off with plane and sandpapered, the rounding extending down on either side to a distance of ⅛", as shown in the sectional view. The frame is now ready to be mitred together, and if it is possible to get access to a mitre box the resulting cuts will be far more accurate than they otherwise would be. The four pieces of sheet steel, 3x 1½x1-32", should now be bent to form perfect right angle braces, and two countersunk holes bored in each leg about 1" from and parallel with the corner of the angle. These holes should be bored for the 1" No. 7 wood screws, and the counters should be on the outside.

The two long sides of the frame should now have two grooves in each, on the No. 1 side, to receive the ends of the brass springs. The measurements are as follows: Gauge a line on sides No. 1 just 1 7-16" from the No. 2 edge, and another parallel line ⅛" from the firstone, then measure in 3" from each extreme end and again measure 4" further in from each of the marks just made, thus forming two spaces 4" long by ⅛" wide. Rabbet these out with a small chisel to a depth of ½", then thoroughly sandpaper each piece, using Nor 1½ and 0 sandpaper, not, however, touching the mitred ends with sandpaper, as jointed surfaces intended to be brought together should never be sandpapered. The plate of glass should now be inserted into the rabbet of all four sides, the frame clamped closely together without the necessity of using nails, dowels or glue.

The ½ pine "backs" should next be finished as per schedule, and to these should be glued the pieces of felt, then the two pieces should be hinged together with just the joints of the hinges showing, as per illustration. The distance of hinges from sides of frame is entirely a matter of judgement, depending upon the size of the frame.

The brass springs are next in order, to be made as follows: Measure in 5½" from each end and square a line across the width of the piece. From these lines bend the ends of the piece upward uutil, when the central flat space (which will be 1½" square) is held firmly on the bench, each end will be 1¼" above the surface of the bench. Then bore a hole through the exact centre of the 1½" square resting surface for a ½" No. 9 screw, and screw in place, allowing just enough "play" for the springs to be swung in and out of the

slots freely. If the tension on these springs is too great or too little, it can be remedied by increasing the height of the bend. This bending, by the way, should be done straight, not curved in any way.

With this, as with other articles of this nature, the matter of size is governed entirely by the character of the work for which the frame is to be used, but for general use the size mentioned here, 12x15″ inside, is very desirable. If desired, one or two coats of white shellac may be applied to the frame, though with cherry one coat of oil is just as useful.

REMOVING AIR BUBBLES.

Air bubles, says the "Amateur Photographers" are a frequent source of misfortune to the beginner chiefly because he does not know how to control them. They are especially difficult to manage when developing the larger sizes of gaslight papers, a large air bell getting beneath the print, and by preventing the developer from flooding the whole surface, causing the image to appear unevenly. Air bubbles are, to a certain extent, prevented by immersing the printing paper in water prior to sweeping on the developer, but should the water be drawn straight from an ordinary tap, it will only add more trouble, owing to the numerous air bubles it will itself contain. Should a large bubble of air get imprisioned under the print, it is quite useless to attempt to get rid of it by dabbing the print with the finger, such procedure only risking the likelihood of marks or scratches. The photograph should be at once lifted up by one corner right ou tof the developer, so allowing the air to escape. Upon letting the print sink down into the developer again, it will be found to lie quite flat, and no risk is run to damaging the film or developing unevenly.

POSING THE HANDS,

The pose of the hands is a favorite topic in photographic journals. It has recently been again pointed out that one of the greatest difficulties in posing hands has been the nervous consciousness of the sitter; but this fact is, fortunately, becoming a thing of the past. The greatest troubles nowadays are the slight exaggeration of the short focus lens, and the belief in many minds that hands are smaller than they really are. Do not (says a writer in *Wilson's Photogaphic Magazine*) let the sitter hear a word about her hand; try to let her forget them. Do not let the hands be placed symmetrically, so that the head looks like tne apex of an isosceles triangle. Hands look more promlnent on dark dresses than on light ones. A nand may be partly hidden by the folds of a dress, or its size may be apparently reduced by placing it sideways to the camera. If it is a natural pose, a hand supporting a cheek or chin looks well. If the fingers are relaxed the hand looks smaller and more natural than when the fingers are stiff. Treat each pair of hands on their merits, usually by leaving them to the natural unconsciousness of the sitter, and the difficulties of posing the hands will in a great measure disappear.

BOOKS RECEIVED.

Electrical Designs. Various authors. American Electrician Co., New York, 9x6; 262 pp. $2.00.

There is probably no book published which would be of greater interest to advanced amateurs. The construction of 34 different pieces of electrical apparatus are fully described, with ample illustrations to make clear the text. Ten motors, five dynamos, galvanometers, coils and similar machines are included. It should be found in the library of every amateur interested in electricity.

Free Hand Lettering. Victor T. Wilson, M. E. John Wiley & Sons, New York, 9x5½; 95 pp, 23 plates. $1.00.

Draftsmen, as a rule, do not give sufficient attention to lettering, yet nothing adds so much to the appearance of drawings as suitable lettering. The book before us treats of the design and work of lettering in a complete and analytical manner, with the result that anyone studying the same should have no difficulty in becoming proficient. The plates giving illustrations of various styles of lettering are exceptionally well done. Teachers in manual training schools, as well as draftsmen generally, will find the book of great value.

Wireless Telegraphy. Charles Henry Sewall. De Van Nostrand Co., New York. 8½x5½; 230 pp. $2.00.

A comprehensive view of wireless telegraphy, its history, principles, systems and possibilities in theory and practice are herein presented with numerous illustrations. Those who are interetted in wireless telegraphy and desirous of learning the technical features of the various systems will find the book of much value. The various parts of apparatus are described in detail, together with much supplementary information.

Technological and Scientific Dictionary. Parts I. and II. George Newnes, Ltd., London, England. 64 pp. each. Paper, 40 cents.

The rapid progress made in recent years in scientific and technical lines have been productive of so many new words and expressions that this dictionary should be of special value to libraries, schools, and those interested in general scientific matter. A very able staff of editors has charge of the composition and editing of the work. The typographical arrangement is excellent.

Methods of Control in Pictorial Photography. A. Horseley Hinton. No. 61 Photo-Miniature. Tennant & Ward, New York.

The mention of the anthor's name is all that is needed to assure readers of its value. It has much of interest to readers, both amateur and professional.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

J. A. COOLIDGE.

VI. The Screw.

Rivalling the lever both in frequency of use and in value is the *Screw*, a machine consisting of a cylinder or cone (See Fig. 16 and 17) with a "thread" or narrow inclined plane wound in spiral form along its length like a spiral staircase on a small scale. Unless it is a common screw of conical shape it is fitted into a nut or receptacle of some shape in which has been made a counter thread or hollow spiral to receive its thread.

FIG. 16.

We shall confine our attention to cylindrical screws, although what we shall say will apply in general to the common screw. In machines, such as the jack screw, the power is applied at the end of a lever and causes the screw to pass through its nut, pushing before it the weight to be lifted or the resistance to be overcome. The common law of machines:—"Power, multiplied by the space through which the power acts,

FIG. 17.

equals the weight multiplied by the space through which the weight moves," will apply, of course, to the screw, although friction will make it seem false.

EXPERIMENT 13.

Take a cylindrical ssrew (see Fig. 16) of rather coarse thread; rub a piece of graphite or soft pencil along one side and then lay it upon a piece of unglazed paper. Press it hard upon the paper and the thread will make a series of short marks corresponding to the ridges in the figure. Measure from one of these marks a space an inch long. (See *XV* Fig. 16.) Count the number of spaces in this line and you will have the number of threads to the inch. Do the same with several screws of differeni sizes, including one or two tapering screws.

For every complete turn of the screw it moves through the nut the space between two threads. If, therefore, there are 12 spaces to the inch the space the weight moves for one turn of the screw is 1-12″. Now, if the screw be that of a carpenter's vise and we apply a force on the handles 14″ from the centre of the screw, the power space will be a circle whose radius is 14″, *i. e.*, 14×2×3 1-7, or 88″. If, in the law of machines, P.

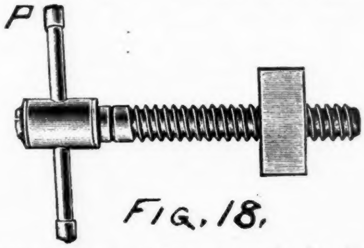


FIG. 18.

×P. space=wt.×wt. space, we supply the distance 1-12″ and 88″ and consider one force equal to 30 pounds, we shall have 30×88=wt.×1-12. This will give us 1-12 of the wt., 2640 or a total value of 31,680 pound, an almost incredible amount. But, as is often the case, ¾ or more of the force is lost by friction. Even with this loss we have an actual result of 7920 pounds resulting from a force of only 30 pounds.

EXPERIMENT 14.

Take the wooden screw and nut from a carpenter's bench (See Fig 18), [half of a carpenter's clamp or even a large iron bolt and nut may be used if the first is not available], find the number of threads to the inch for wt. space, and measure the length of this handle from the centre of the screw to the point P. At P. attach the spring balance used in former experiments. Bore a small hole in the lower end of the screw and turn in a screw eye. On the screw eye hang a weight *W*. Fasten the nut firmly so that as the power is applied at P. the weight shall be raised.

FIG. 19.

Using the law P.×P. space=wt.×wt. space, supply all the values except the power. Wt. space equals the distance between two threads of the screw. P. space equals 2×3 1-7× the length of the handle, *i. e.*, if the length, *AP*, in Fig. 16, is 14″ it will be 2×3 1-7×14, or 88″. With a known weight *W*, say eight pounds or more, calculate what the power should be. Now pull on the balance and make a number of trials until you have obtained a constant value for P. Should it be

four times as large as the value calculatad, do not be surprised, as this shows the exceedingly large amount of friction. You may say, of what use is the screw when $\frac{3}{4}$ of the force is lost? If you will recall our study on friction you will remember that friction is a great help as well as a hindrance, and here we can see the need of this friction. Suppose we are clamping a piece of elastic wood in a vise and that, as soon as this wood is pressed between the jaws of the vise the elastic wood pushes back and the jaws are pushed as far open as before. As it is now, the friction of the screw in its nut prevents the vise from opening, but if that did not hold, some other contrivance would be necsssary to prevent slipping.

If the heavy weight resting on a "jack" exerted a downward force great enough to overcome the friction of the screw, the screw wou.d turn backward and the weight fall slowly. We can see the value of what really hinders the motion of the power.

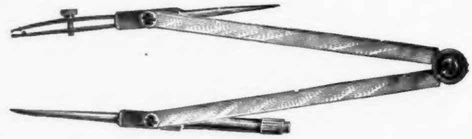
Of the many screws in use, especially the larger ones, perhaps those that will impress us as being most valuable are those used in vises, carpenters, clamps, letter presses, presses used for various purposes, wagon jacks and, most of all, the large jacks put under a house to raise it. These, with the many screws and bolts used for various purposes, will convince us of the great value of the screw.

THE WEDGE.

Although a machine less used than any of the others, a series of articles would be incomplete without a brief mention of the wedge. It is really an inclined plane, or a double inclined plane with the bases joined so that both long surfaces are oblique to the edge of the height. See Fig. 19. The power, instead of pushing the weight steadily up the plane, by quick, successive blows drives the wedge under the weight, or, as in splitting wood, between the portions to be moved or separated. Because of the method of applying the force, *i. e.*, by quick, repeated blows, as well as on account of the great friction, any simple experiments with the wedge are out of the question. The law of the wedge is, as in all machines, P.×P. space=wt.× wt. space, and, as seen in Fig.19., if AB is 12″ and DC 2″ with a force of 200 pounds; 300×12=2×wt., therefore the weight equals 1,800 pounds. Much of this will be lost by friction, however, but notwithstanding the loss, much is gained. The wedge is used in lauching ships, in raising buildings or parts of buildings for short distances, in laying floors and splitting wood. It can be used when the other machines cannot be applied, and proves a very valuable machine. E. E.

TRADE NOTES.

A cheap, portable, yet strong and accurate pair of Pocket Compasses has long been the wish of all whose occupation involves the use of drawing instruments, such as builders, draftsmen, mechanics, engineers, surveyors, architeots, students, etc. Heretofore all pocket compasses were either too cheap to be specially accurate and durable, or so high in price as to forbid their general use.



Kolesch & Co., 138 Fulton St., New York, have lately placed on the market an instrument which overcomes these drawbacks while it embodies strength, accuracy, durability. The "Indispensable" Combination Drawing Set, as shown in illustration, consists of a pair of dividers, pencil compasses and pen compasses in one piece. As can be seen in the cut, the pen and pencil point are each made integral with one of the steel, points, and each one of these pieces is firmly riveted to one of the legs; it is reversable, so that either the steel point or the pen and pencil point can quickly be brought down on the drawing surface. By this method there are no loose parts or screws, which might get lost, while the instrument is readily adjusted for use. The instrument is made of strong steel bent and braced to make it as rigid as possible. The points are very strong and of an improved style so that they will never lose their adjustment. When closed the instrument is very compact and weighs only $\frac{3}{4}$ oz. The instrument is nicely finished and nickel plated.

It is also furnished in a neat, strong pocket case which also holds a good 5″ Ruling Pen. A descriptive circular will be sent on application. The price is 75 cents without drawing pen; $1.25 with pen in pocket case.

The Saw Bench sold by the Frasse Co., 38 Cortland St., New York, is a very necessary tool in all shops where the ripping or sawing of wood is of much account. It is furnished both with foot power and hand crank, and provision is made for cutting thick wood. Two saws are provided for different operations, also an emery wheel, which can be employed for sharpening chisels, plane irons, skates and general grinding. The purchase of one of these machines by a carpenter enabled him to fit a number of doors in a hotel contract that he had taken, and he stated that he was able to do more than fifty times the work than if he had used a hand saw. A descriptive circular will be sent upon request.

Amateur Electricians who have purchased secondary windings from the New England Coil Winding Co. are much pleased with the construction and workings of these coils. They ane just the thing for amateurs who are interested in electrical experiments requiring coils.

By treating zinc with aluminium in various proportions, nine different well-defined alloys have been obtained.